PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
D21H 19/82, 19/64, 19/20, 21/16, 27/10, 27/30, E04C 2/26, B32B 13/08

A1

(11) International Publication Number: **WO 99/57371**

(43) International Publication Date: 11 November 1999 (11.11.99)

(21) International Application Number: PCT/AU99/00324

(22) International Filing Date: 4 May 1999 (04.05.99)

(30) Priority Data:

PP 3323	4 May 1998 (04.05.98)	AU
PP 6281	1 October 1998 (01.10.98)	AU

(71) Applicant *(for all designated States except US)*: VISY R & D PTY LTD. [AU/AU]; Level 2, 533 Little Lonsdale Street, Melbourne, VIC 3000 (AU).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: DAWSON, Ronley, John [AU/AU]; 238 Carrick Drive, Gladstone Park, VIC 3042 (AU).

(74) Agent: CARTER SMITH & BEADLE; Qantas House, 2 Railway Parade, P.O. Box 557, Camberwell, VIC 3124 (AU).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: LINER FOR PLASTERBOARD

(57) Abstract

A paper liner for a plasterboard has a base paper with a surface size applied to one surface. The surface size includes oxidized starch, as sizing agent selected from the group consisting of alkenyl succinic anhydride, succinic anhydride, wood rosin, alkyl ketene dimer and mixtures thereof, and an acrylic containing polymer. A coating including at least one inorganic filler and at least one binder is applied to the side of the paper having the external surface size. The surface size and coating are sufficiently porous to enable drying of the gypsum slurry used in manufacture of the plasterboard. The paper also provides a surface that can be printed with a decorative pattern and does not require painting or wall papering to provide and esthetically pleasing appearance.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

LINER FOR PLASTERBOARD

The present invention relates to a paper liner for plasterboard, a method for making plasterboard and a plasterboard product. The plasterboard product is especially a decorative plasterboard panel.

Plasterboard, also widely referred to as gypsum board, is widely used in the building and construction industry. Plasterboard finds especially wide use as an internal wall cladding and ceiling infill material.

In the production of plasterboard, a gypsum slurry is cast between top and bottom paper liner sheets and dried in a kiln to convert the gypsum slurry to $CaSO_4.2H_2O$. The drying process requires removal of water from the slurry. As the slurry is essentially completely encased in the paper, the water that is removed from the slurry during drying must pass through the paper liner sheets. Consequently, in addition to having sufficient strength to support the gypsum paper, the paper must also be sufficiently permeable to allow water or water vapor to pass therethrough during drying at a sufficient rate to ensure that acceptable drying rates are achieved.

If the paper is insufficiently permeable to water or water vapor for the drying rate used in plasterboard manufacture, water can build-up under the paper liner and turn into steam. This can lead to delamination, peelers or debonding between the paper liner and the plaster, which results in an unacceptable plasterboard product.

The paper liner used in plasterboard manufacture has a gypsum side and an external side in the final plasterboard product. The gypsum side of the paper liner is conventionally coated during it manufacture with a silicone or polysiloxane containing agent prior to casting of the gypsum slurry. The silicone or polysiloxane containing agent strengthens the adhesion between the gypsum and the liner in the plasterboard product.

The plasterboard product also has two external faces, with the external faces comprising the respective external faces of the two paper liner sheets. One of the external faces of the plasterboard, in use, faces into a wall cavity or ceiling cavity and is hidden from view. Accordingly, the appearance of this external surface of

the plasterboard is not especially critical and this allows the paper liner used on this surface to be designed to have properties that are especially suitable for plasterboard manufacture, including high porosity to achieve good drying rates.

The other external surface of the plasterboard will, in use, face into a room and accordingly provides a visible surface. Therefore, the appearance of this surface is somewhat more important. Plasterboard almost invariably is manufactured such that this external surface has a fairly dull colour that darkens with age. However, this surface does accept a paint coating or wallpaper and such steps have traditionally been used to obtain an aesthetically pleasing appearance in the completed building.

Some attempts have been made to produce a plasterboard that does not require painting or wallpapering immediately upon installation in a building. For example, Australian Patent Application No. 19322/92 in the name of Platres Lafarge describes a paper used as a lining paper for plasterboard. This paper has an external surface that provides durable aesthetic qualities without affecting the process of manufacture of plasterboard incorporating the paper.

The paper described in AU 19322/92 is coated with a pigment layer. Although the patent application states that the paper provides "durable aesthetic qualities", the application unambiguously states that the coated paper is in turn intended to be coated with a decorative layer, for example, of wallpaper or of paint. Accordingly, AU 19322/92 does not provide a long-term solution to providing a plasterboard that has acceptable aesthetic appearance without requiring painting or wallpapering.

The paper described in AU 19322/92 includes a top ply that is made from bleached, predominantly chemical, cellulose fibers and a light coloured, preferably white, inorganic filler. The paper is coated with a coating that includes at least one light-coloured (preferably white) inorganic filler and at least one binder, together with other adjuvants. The coating is applied at a rate of 6 g/m^2, more preferably 8-30 g/m^2. The permeability of the coated paper is generally higher than 100 sec (Gurley) and is more generally of the order of 150 sec (Gurley). In order to obtain suitable aesthetic qualities, AU 19322/92 requires that the amount of unbleached

chemical pulps, thermomechanical pulps, semichemical pulps and mechanical pulps in the top ply be held to less than 30% and that the pulp in the top ply be predominantly bleached pulp.

As mentioned above, the plasterboard product described in AU 19322/92 will still require painting or wall papering to retain a satisfactory appearance.

Ceilings in office buildings and other commercial buildings frequently comprise "hanging ceilings" in which a supporting structure is hung from the roof or the floor above and infill panels are supported by the supporting structure. Such ceilings allow sufficient space for electrical cabling, plumbing and air-conditioning ducts to be placed whilst providing a pleasing appearance that hides the building services running above the ceiling. The ceiling infill panels are commonly made from fibrous lightweight materials and present a speckled appearance.

It is an object of the present invention to provide a paper liner for plasterboard that provides a satisfactory appearance without the necessity of applying a further coating, such as paint or wallpaper, after installation of the plasterboard.

In a first aspect, the present invention provides a paper liner for a plasterboard including a base paper having a surface size applied to one surface thereof, the surface size including oxidized starch, wood rosin and cationic styrene/acrylic esters co-polymer, a sizing agent selected from alkenyl succinic anhydride, succinic acid anhydride, wood rosin, alkyl ketene dimer and mixtures thereof, and an acrylic-containing polymer, said paper further including a coating applied to the one surface thereof, said coating including at least one inorganic filler and at least one binder.

The base paper used in the present invention preferably comprises a multi-ply paper, more preferably a three-ply paper. The base is preferably of relatively low grammage, such as 160-180 g/m^2. The top ply of the base paper may be made from white deinked pulp, for example, white deinked pulp obtained from recycling of newsprint and waste office paper. Other pulps may be used in the manufacture of the top ply, including white quality unprinted waste paper, chemical bleached

cellulose fibres and optionally bleached mechanical, CMP, TMP and CTMP cellulose fibres.

The base paper should have sufficient porosity to render it suitable for use in the manufacture of gypsum board. The base paper preferably has a porosity in the range of 18-28 sec, determined in accordance with Australian Standard 1301.4205-89 for the Gurley air permeance of paper. This test measures the time in seconds required for 100ml of air at specified conditions to permeate through the paper. For convenience, this test will hereinafter be referred to as "Gurley".

The base paper should also have sufficient strength for gypsum board manufacture and its end uses.

An especially preferred base paper has the following properties:

Thickness:	$300 \pm 6\mu m$
Grammage:	170 ± 10 g/m^2
Moisture (%):	6.5 - 8.5
Tensile Strength (conditioned):	
Machine Direction (MD)	10.0 - 10.3 kN/m
Cross Direction (CD)	4.05 - 4.2 kN/m
Gurley Porosity (sec):	18 - 28
Wet Expansivity:	0.9% max

The base paper is preferably at least two ply, more preferably three ply.

The base paper preferably includes an inorganic filler and a cationic acrylamide copolymer. These components are added to the pulp suspension used to manufacture at least the top ply of the base paper and preferably to all plies and become incorporated into the base paper. These components control the porosity and density of the paper. The inorganic filler may be bentonite clay such as hydrocol HSI or hydrocol ONZ, both manufactured by Allied Colloids. The cationic acrylamide copolymer may be NALCO 7541 manufactured by Nalco or PERCOL 47 or PERCOL 57, both manufactured by Allied Colloids.

The paper liner in accordance with the present invention is intended to have a gypsum side and a decorative side. The base paper has an external surface size applied to one surface thereof and a coating also applied to that surface. That

surface of the paper liner is intended to be the decorative side of the plasterboard. For convenience, this surface will hereinafter be referred to as "the decorative surface" or "the decorative side" of the paper liner.

The external surface size applied to the decorative surface of the base paper controls the distance that the coating penetrates into the paper. This is important for controlling the void area (porosity) of the final paper liner.

The external surface size includes three main components, which may be identified broadly as oxidized starch, a sizing agent and an acrylic-containing polymer. The three main components of the external surface size may be applied sequentially, with the starch being applied first, followed by the sizing agent and then the acrylic-containing copolymer. Alternatively, and preferably, the three main components may be mixed to form a sizing composition and the sizing composition applied to the paper at one location.

The oxidized starch is preferably oxidized wheaten starch. Sizing with oxidized starch assists in improving the strength of the base paper which in turn provides increased strength to the plasterboard. Increased plasterboard strength is desirable to minimise or prevent sagging of the plasterboard during use. Furthermore, the thickness of the plasterboard may be minimised.

The oxidized starch has preferably a balance between film forming and sheet penetration properties. When the coating is applied, it can migrate just sufficiently to form a bond with the paper.

It is believed that the degree of oxidation of the starch may be an important parameter in the present invention, although further work is required to confirm this. A degree of oxidation equivalent to oxidizing the starch with 0.18 to 0.40% wt of ammonium persulphate, more preferably 0.18 to 0.35% wt of ammonium persulphate (calculated as a weight percentage on the weight of starch) is especially preferred.

The original starch may have a particle size in the range of 2 to 100μm.

It is preferably passed through a steam jet cooker where disruption of the granule is accomplished by a nearly instantaneous temperature increase, for example, to about 165°C, and intensive mechanical shearing occurs. The ability of

starch to act as an effective interfibre bonding agent for paper is directly related to both the degree of molecular dispersion and to molecular weight. The person skilled in the art would know to balance these factors in cooking in order to optimise performance.

If alkenyl succinic anhydride is used, it is preferred that it comprises C_{16} to C_{18} alkenyl succinic anhydride. Such compounds have been widely used as paper sizing agents and need not be described further. A suitable alkenyl succinic anhydride is NALSIZE 7540, manufactured by Nalco.

In the event that alkenyl succinic anhydride is used, it is preferred that an acrylamide copolymer is also included in the sizing composition. The acrylamide copolymer is preferably added in colloidal form and it acts to aid emulsion formation, as a protectant and retention aid to the alkenyl succinic anhydride.

Alkyl ketene dimer and wood rosin may also be used as the sizing agent. Both are well known paper sizing agents and need not be described further. A suitable wood rosin is DSPC4 manufactured by Hercules. A suitable alkyl ketene dimer is KEYDIME C100 manufactured by Eka Nobel.

The external surface size includes an acrylic-containing copolymer. This is preferably a cationic styrene/acrylic ester copolymer, for example, the product sold under the trade name Baysynthol manufactured by Bayer.

The components of the external surface size are preferably added in the following amounts, based upon a base paper of nominal grammage of 170 g/m^2:

Oxidized starch:	3 - 4% on total mass
Sizing agent:	4kg/tonne
Acrylic containing polymer:	1.3g/m^2

The external surface sizing up is preferably applied to the paper as a mixed composition. It is preferably applied to the paper on the paper machine during manufacture.

The paper that comes off the paper making machine preferably has the external surface sizing applied to the decorative side of the paper. The decorative side of the paper preferably has a brightness of about 60 ISO brightness units at this stage.

In order to improve the bond that develops between the gypsum and the back of the paper, the back of the paper may be surface sized with a silicone or polysiloxane sizing agent. The person skilled in the art of plasterboard manufacture would readily appreciate which silicone/polysiloxane surface agents would be suitable. One suitable agent is RE29 silicone/polysiloxane manufactured by Union Carbide.

The decorative side of the paper has a coating applied thereto. The coating may be described as a light weight, open coating of 7-11g/m_2. The coating comprises at least one inorganic filler and at least one binder. The inorganic fillers are preferably of or include a fraction of a relatively large particle size. The coating is preferably of high alkalinity. More preferably the coating composition has a pH of at least 8.5.

The inorganic fillers may comprise a mixture of different inorganic fillers. The inorganic fillers may include calcium carbonate, clay, aluminium silicate, calcined clay and titanium dioxide.

Preferably, the inorganic fillers comprises a mixture of large particle sized precipitated calcium carbonate, aluminium silicate and clay, and titanium dioxide.

The calcium carbonate preferably is sized such that most of the particles of calcium carbonate fall within the range of 10-40μm. The aluminium silicate is preferably sized such that most of the particles of aluminium silicate fall within the range of 10-40μm. The calcined clay particles are sized such that most of the particles fall within the range of 2-10μm. The titanium dioxide is a very fine powder and has particles largely sized within the range of 0.1-0.3μm.

The coating that is applied to the decorative side of the paper tends to decrease the permeability of the paper. In order to enable the paper to be used as a liner in plasterboard manufacture, the coated paper has to at least be able to "sweat" which thereby allows removal of at least some water from the drying gypsum slurry through the decorative side of the plasterboard. To ensure this, the amount of very fine inorganic filler particles should be minimized as the fine particles tend to fill the interstitial spaces in the coating thus forming a closed coating which has low permeability.

In order to ensure that the coating adheres to the paper, one or more binders are used. These binders may include styrene butadiene latex, polyvinyl acetate and acrylic latex.

The coating is preferably applied to the decorative side of the paper by mixing the inorganic filler and the binder to form a coating composition and thereafter applying the coating composition to the paper. Coating may be achieved by use of a rod or air knife or trailing blade coater that has a gloss calendar. The applied coating may be dried by infra-red dryers, such as gas fired infra-red dryers.

The coated paper provides a paper liner that has a coating on the decorative side that presents an attractive aesthetic appearance. Moreover, the coating has a low tendency to yellow or discolour over time and it presents a washable surface such that dust and smoke deposits can be removed therefrom. The coated paper also shows some permeability to water and allows water to sweat therethrough, which allows at least some water to be removed from the decorative side during drying in plasterboard manufacture.

In an especially preferred embodiment of the present invention, the decorative surface of the paper liner is printed with a pattern to further improve its appearance. Flexoprinting may be used to print the pattern, utilizing flexographic ink of improved light fastness.

The printing may result in a speckled pattern being applied to the decorative surface of the paper liner such that, if the plasterboard is used as a ceiling infill panel, the panel has an appearance similar to the speckled appearance of conventional ceiling infill panels. Other patterns or designs may also be printed onto the decorative side of the paper liner.

The present invention provides a unique solution to providing plasterboard having a decorative appearance. Rather than looking to improve the painting or wallpapering ability of the plasterboard as was common in the prior art, the present invention instead provides a paper liner that is coated and optionally printed and that provides a durable, washable decorative surface that does not require painting or wallpapering. The external surface size and coating on the decorative side surprisingly allow sufficient water permeability to let water permeate through the

decorative side and permit at least a degree of water removal through the decorative side of the plasterboard during the drying step in plasterboard manufacture. This has not herebefore thought to be possible.

In another aspect, the present invention provides a method for producing a paper liner for plasterboard including the steps of applying an external surface sizing as hereinbefore described to a base paper and subsequently applying a coating as hereinbefore described to the paper. The method preferably further includes the step of printing a pattern onto the coated surface of the paper.

The present invention also includes a method for producing plasterboard.

In a third aspect, the present invention provides a method for producing plasterboard including the steps of casting gypsum slurry between two liner sheets of paper and drying the slurry, wherein one of the liner sheets of paper comprises a paper liner as described herein.

Preferably, the other of the liner sheets of paper comprises the base paper used in the paper liner described herein. The liner sheet that comprises the paper liner as described herein will comprise the decorative side of the plasterboard. This liner has reduced permeability to water vapor and water but has sufficient permeability to enable water to sweat therethrough. Accordingly, at least some drying will occur through this paper liner.

The other liner sheet may be the base paper described herein or any other high porosity paper suitable for use in the manufacture of plasterboard. In practice, a greater portion of drying will take place through this sheet.

The drying rate of the plasterboard may have to be adjusted downwards in order to account for the reduced permeability of the decorative side paper liner. Simple trial will establish the required drying rate. The present inventors have found that satisfactory drying rates are able to be obtained in the method for producing plasterboard in accordance with the present invention.

The invention also extends to encompass plasterboard produced in accordance with the method described above.

The invention also encompasses plasterboard having a decorative side comprising a paper liner as described herein in accordance with the first aspect of

the present invention. The decorative side does not require further processing to provide a suitable aesthetic appearance. In particular, painting or wallpapering is not required.

The decorative side of the paper liner may have a brightness of 70-90 ISO brightness units. The decorative side accepts printing, especially flexoprinting, and presents a washable durable, colorfast surface. The coated and printed paper liner also has sufficient permeability to enable it to be used in the manufacture of plasterboard. This is due to the "open" coating that has been applied to the paper liner.

Specific embodiments of the present invention will now be described with reference to the following Examples. It will be appreciated that if Examples are intended to illustrate the present invention they should not be construed as limiting the present invention in any way.

Example 1

A 3-ply sheet of paper was manufactured from deinked white office waste, corrugated waste, old corrugated cartons and selected brown waste. The following fillers/chemicals were added to the paper:

	Top Ply	Middle Ply	Bottom Ply
PERCOL 57	80 g/T	400 g/T	470 g/T
BENTONITE	Nil	2.6 kg/T	2.6 kg/T
ALUM	5kg/T	3 kg/T	3 kg/T

An external surface size was applied to the top ply. This size included oxidized starch having 7% solids at size press oxidized by addition of 0.20-0.28% ammonium persulphate. The starch was added to the paper in an amount of 25-40 kg/tonne. The size also included Baysynthol at 1-2kg/tonne and alkenyl succinic acid (top ply -4.5kg/T, middle ply -4kg/T, back ply -5kg/T). A coating of inorganic fillers and binder was applied and the coated paper was flexoprinted.

The paper was used as one sheet in plasterboard manufacture and an acceptable plasterboard product was produced using a drying rate of 3.2kg $H_2O/m^2/hr$.

Example 2

A commercial run was carried out on a 3 ply paper machine to produce base paper for coating in order to make printable marketable gypsum board for ceiling in fills. The paper line was set to make convention plasterboard liner utilizing 100% deinked waste on the top ply and other conventional paper stock brown and mixed whites on the other plies. After the line is running, adjustment of the bentonite clay and cationic acrylamide occurs at the wet end of the paper machine. The rates of addition to T-top ply, M-middle ply and B-bottom ply are percol 57 (acrylamide) T-50-100g/t, M-300-500g/t, B-400-600g/t, hydrocol ONZ T-nil, M-2.6kg/t, B-2.6kg/t. The initial paper is comprised of alkenyl succinic anhydride (nalco 7540) internally sized with the addition of cationic acrylamide (nalco 7541) at T-4.5kg/t, M-4kg/t, B-5.0kg/t. The change to process occurs at the size press where on the back of the sheet (the gypsum combining side) has silicone emulsion RE29 applied at 7.6kg/t and to the face or top side, the decorative side, oxidized starch 25-40kg/t together with wood rosin and cationic styrene/acrylic esters copolymer (Baysynthol) 1-2kg/tonne is applied. The paper so formed are more porous and give up water by drainage and drying more readily than conventional plasterboard liner encasting sheets and the surface sizing of the paper allows the desired surface for the next process step i.e. coating.

The off machine base sheet was then cut in two widths one width to suit subsequent backpaper for the gypsum board process and another width for the coater. Thence the face paper for gypsum board production. The face paper web was coated on its proposed decorative surface through a rod/airknife/rod coater that has a gross calendar. Both rod/air knife at coating weight of 12-18g/m^2 and air knife only coatings (8-11g/t) were produced. The coater is a standard coater manufactured by Kohler and has gas fired infrared dryers after each coating station. The coating kitchen is of standard design and has standard equipment for preparation of coating mixes for rod air knife coaters desired for both flexographic and lithographic printing processes.

A typical coating mix for flexographic printing is:

Water	%
Bevaloid 211	24.0
Ammonia	0.46
KGIO Biocide	0.010
Gensil 2015	0.019
Tioxide	6.16
Tixolex	4.11
Kingwhite 80	24.66
Ansilex	6.16
Water	19.882
DL 945 Latex	12.20
Bevaloid 6681	0.39
Berset	0.535
Nopcote 650	0.626
Polyphobe	0.500
Water	0.500
Bevaloid 6681	0.29

The paper once coated is suitable for quality flexographic printing and is porous enough to be able to be used as face paper on a conventional gypsum board line and poses little drying problems.

A gypsum board was produced on a conventional gypsum wallboard line using natural gypsum at 11 metres per minute. Standard known chemical additives were used with the stucco namely BGA, potash, boric acid, durasar, soap, starch and retarder. Liquid/plaster ratio of 85-89% and slump measurements of 95-105 were recorded.

Drying was carried out in a two stage conventional gypsum board dryer and a drying rate of 3.2kg of $H_2O/m^2/hr$ was achieved.

This procedure is all known to plasterboard manufacturers.

COATING CHEMICALS	SUPPLIERS
Bevaloid 211 - Polycarboxylic Acid Bevaloid 6681 - Proprietary Mineral Oil	(Rhone-Poulenc)
KG10 Biocide - Methyl Chloro Isothiazolin	(PPIC Australia)
Gensil 2010 – Silicone	(Rhone-Poulenc)
Tioxide RHD-2 - Titanium Dioxide	(Tioxide Australia)
Tixolex 17 - Aluminium Silicate	(Rhone-Poulenc)
Kingwhite 80 – Clay	Kingaroy Kaolin
Ansilex 93 - Calcined Clay	Angelhard
DL 945 Latex - Styrene Butadiene	Pacific Inks/Dow
Berset 86 - Methanol/Formaldehyde	Valchem-Orica
Nopcote 6501 - Calcium Stearate	Henkel
Polyphobe 208 – Polyurethane	Dow

The various chemicals described herein as being able to be used in the paper liner of the present invention have been used in the paper industry for many years and are well known proprietary products. However, the formulation of these products remains a trade secret and it is not possible to provide further information on their composition other than that provided herein. As the products are known, it is expected that the person skilled in the art would immediately recognize what chemicals are required from the generic description of such chemicals and also understand what substitute products may be used to achieve the same end.

CLAIMS:

1. A paper liner for a plasterboard comprising a base paper having a surface size applied to one surface thereof, the surface size including oxidized starch, a sizing agent selected from alkenyl succinic anhydride, succinic acid anhydride, wood rosin, alkyl ketene dimer and mixtures thereof, and an acrylic-containing polymer, said paper further including a coating applied to the one surface thereof, said coating including at least one inorganic filler and at least one binder.

2. A paper liner as claimed in claim 1 wherein the base paper comprises a multi-ply paper.

3. A paper liner as claimed in claim 1 wherein the base paper has a grammage of 160-180g/m^2.

4. A paper liners as claimed in claim 2 wherein a top ply of the base paper is made from white deinked pulp obtained from recycling of newsprint and office paper, white quality unprinted waste paper pulp, chemical bleached cellulose fibres or optionally bleached mechanical, CMP, TMP or CTMP cellulose fibres.

5. A paper liner as claimed in claim 1 wherein the base paper has a Gurley permeance of 18-28 seconds.

6. A paper liner as claimed in claim 1 wherein the base paper has the following properties:

Thickness:	300 ± 6μm
Grammage:	170 ± 10 g/m^2
Moisture (%):	6.5 - 8.5
Tensile Strength (conditioned):	
Machine Direction (MD)	10.0 - 10.3 kN/m
Cross Direction (CD)	4.05 - 4.2 kN/m
Gurley Porosity (sec):	18 - 28
Wet Expansivity:	0.9% max

7. A paper liner as claimed in claim 1 wherein the base paper includes an inorganic filler and a cationic acrylamide copolymer.

8. A paper liner as claimed in claim 1 wherein the oxidized starch comprises oxidized wheaten starch.

9. A paper liner as claimed in claim 1 wherein the oxidized starch has a degree of oxidation equivalent to oxidizing the starch with 0.18 to 0.40wt% ammonium persulphate, calculated as a weight percentage on the weight of the starch.

10. A paper liner as claimed in claim 1 wherein the alkenyl succinic anhydride comprises C_{16} - C_{18} alkenyl succinic anhydride.

11. A paper liner as claimed in claim 1 wherein the external surface size includes alkenyl succinic anhydride and further comprises an acrylamide copolymer.

12. A paper liner as claimed in claim 1 wherein the acrylic-containing copolymer comprises a cationic styrene/acrylic ester copolymer.

13. A paper liner as claimed in claim 12 wherein the cationic styrene/acrylic ester copolymer comprises the product sold under the trade name Baysynthol by Bayer AC.

14. A paper liner as claimed in claim 1 wherein a decorative side of the paper has a brightness of about 60 ISO brightness units following application of the external surface size.

15. A paper liner as claimed in claim 1 wherein the coating is applied at a rate of 7 to 11g/m^2.

16. A paper liner as claimed in claim 1 wherein the coating has a pH of at least 8.5.

17. A paper liner as claimed in claim 1 wherein the inorganic fillers are selected from the group consisting of calcium carbonate, clay, aluminium silicate, calcined clay, titanium dioxide and mixtures thereof.

18. A paper liner as claimed in claim 17 wherein particles of calcium carbonate substantially fall within the size range of 10-40μm, particles of aluminium silicate substantially fall within the size range of 10-40μm, particles of calcined clay substantially fall within the size range of 2-10μm, and particles of titanium dioxide substantially fall within the size range of 0.1-0.3μm.

19. A paper liner as claimed in claim 1 wherein the at least one binder is selected from the group consisting of styrene butadiene latex, polyvinyl acetate and acrylic latex.

20. A paper liner as claimed in claim 1 wherein the paper liner is sufficiently permeable to allow water to sweat through the paper liner.

21. A paper liner as claimed in claim 1 wherein a decorative side of the paper liner is printed with a decorative pattern.

22. A paper liner as claimed in claim 1 wherein a side of the paper in contact with gypsum in finished plasterboard is surface sized with a silicone or polysiloxane sizing agent to improve bonding between the paper liner and the gypsum.

23. A plasterboard having a layer of gypsum sandwiched between two liner sheets characterized in that at least one of the liner sheets comprises a paper liner as claimed in claim 1.

24. A plasterboard as claimed in claim 23 wherein one of the liner sheets comprises a paper liner as claimed in claim 1 and the other liner sheet comprises a base paper.

25. A paper liner as claimed in claim 1 wherein a decorative side of the paper liner has a brightness of 70-90 ISO brightness units.

26. A method of producing plasterboard comprising the steps of casting gypsum slurry between two liner sheets of paper and drying of the gypsum slurry, characterized in that at least one of the liner sheets comprises a paper liner as claimed in claim 1.

27. A method of producing a paper liner for a plasterboard comprising the step of applying an external surface size including oxidized starch, a sizing agent selected from the group consisting of alkenyl succinic anhydride, succinic acid anhydride, wood rosin, alkyl ketyl dimer and mixtures thereof and an acrylic-containing polymer, and applying a coating comprising at least one inorganic filler and at least one binder.

28. A method as claimed in claim 27 comprising the further step of printing a pattern on the coating.

29. A method as claimed in claim 27 wherein the acrylic containing copolymer comprises a styrene/acrylic ester copolymer.

30. A method as claimed in claim 27 wherein the alkenyl succinic anhydride comprises C_{16}-C_{18} alkenyl succinic anhydride.

31. A method as claimed in claim 27 wherein the surface size includes alkenyl succinic anhydride and further includes an acrylamide copolymer.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00324

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: D21H 19/82, 19/64, 19/20, 21/16, 27/10, 27/30, E04C 2/26, B32B 13/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC D21H, E04C, B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT, JAPIO

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 84-275183/44, Class A97 F09, SU 1079722 A (PAPER CENT RES INST), 15 March 1984	1-31
X	US 4470877 (JOHNSTONE ET AL.), 11 September 1984 Whole document	1-31
X	US 4548676 (JOHNSTONE ET AL.), 22 October 1995 Whole document	1-31

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 July 1999	09 JULY 1999

Name and mailing address of the ISA/AU
AUSTRALIAN PATENT OFFICE
PO BOX 200
WODEN ACT 2606
AUSTRALIA
Facsimile No.: (02) 6285 3929

Authorized officer
ADRIAN GILLMORE
Telephone No.: (02) 6283

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU 99/00324

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	4548676	AT	9028/92	AU	85297/82	BE	895576
		CA	1175611	CH	661006	DE	3245988
		DK	5444/82	EP	78838	FI	830080
		FR	2505908	GB	2102038	IE	52660
		IT	1234413	MX	162289	NL	8220198
		US	4372814	WO	8204014	ZA	8203313
		US	4470877	US	4853085	CA	1212506
		FR	2536012	GB	2130265	JP	59100799
		NL	8303918	NZ	206000	CA	1220904
		SE	8296986				

END OF ANNEX